

# Intersection Conflict Warning Systems



Michigan Traffic Safety Summit  
March 26, 2013

# Outline

- ENTERPRISE Program
- Intersection Conflict Warning Systems
- Design and Evaluation Guidance
- Systems Engineering
- Next Steps



# ENTERPRISE Program

- What is a transportation pooled fund?
  - Allows federal, state, and local agencies and other organizations to combine resources to support transportation needs
  - Federal, state, regional or local transportation agencies may initiate pooled fund studies
    - Private companies, foundations, and colleges/universities may partner with any or all of the sponsoring agencies to conduct pooled fund projects
  - Approved by FHWA



# ENTERPRISE Program

## Design and Evaluation Guidance for Intersection Conflict Warning Systems (ICWS)

Version 1: December 2011



## ENTERPRISE Program FY 2012 Work Plan

Prepared for the  
ENTERPRISE Pooled Fund Study  
TPF-5(231)

Prepared by



## Understanding Utilization of Third Party Data and Information Final Report

Evaluating **N**ew **T**Echnologies for  
**R**oad **P**Rogram **I**nitiatives in **S**afety  
and **E**fficiency



# ENTERPRISE Program

- Goals
  - Facilitate rapid progress in the development and deployment of ITS technologies
  - Accelerate the systematic advancement of selected ITS projects
    - Members carry out ITS projects and activities including fundamental research, technology development, demonstration, standardization and deployment



# ENTERPRISE Program

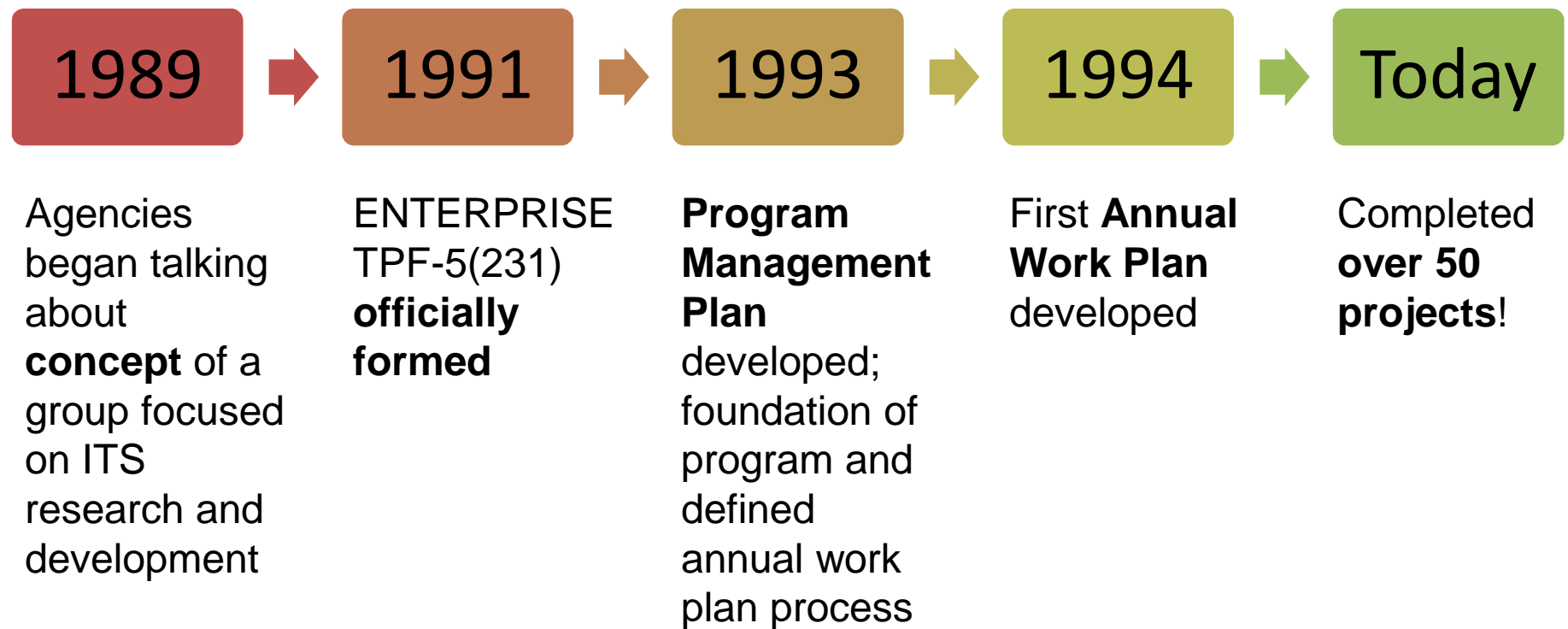
## Members

- Arizona DOT
- Georgia DOT
- Idaho Transportation Department
- Illinois DOT
- Iowa DOT
- Kansas DOT
- Maricopa County, Arizona
- ***Michigan DOT\****
- Minnesota DOT
- Mississippi DOT
- Oklahoma DOT
- Texas DOT
- **Virginia DOT???**
- Washington State DOT
- Ministry of Transport Ontario
- Transport Canada
- Dutch Ministry of Transport
- FHWA

***\* Michigan DOT administers program and is a founding member***

# ENTERPRISE Program

## Major Milestones



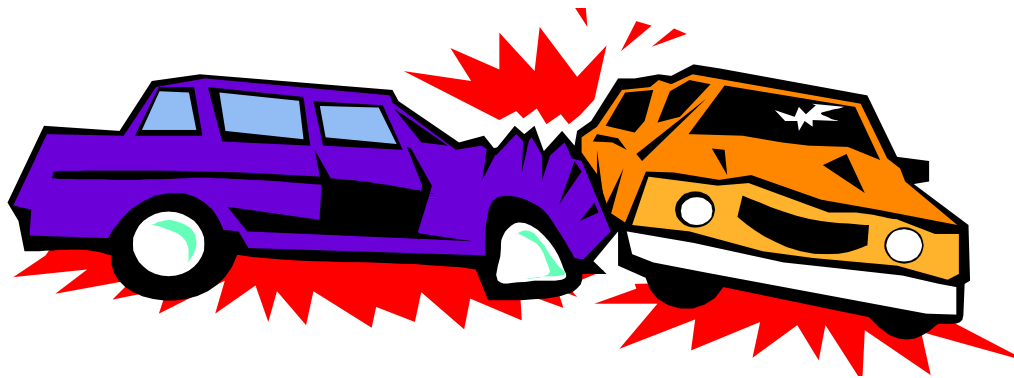
# ENTERPRISE Program

- Recent projects
  - Warrants for ITS Devices
  - Understanding Utilization of Third Party Travel Data and Information
  - Impacts of Travel Information on the Overall Network
  - Next Era of Traveler Information
  - ***Developing Consistency in ITS Safety Solutions – Intersection Conflict Warning Systems***
  - ***ICWS Coordination and Systems Engineering***



# Intersection Conflict Warning Systems

- Nature of the problem
  - 2,210,000 crashes at intersections in 2009 (US)
    - 40% of the 5,505,000 total crashes
    - 46% of the 699,000 injury crashes
    - 22% of the 6,770 fatal crashes



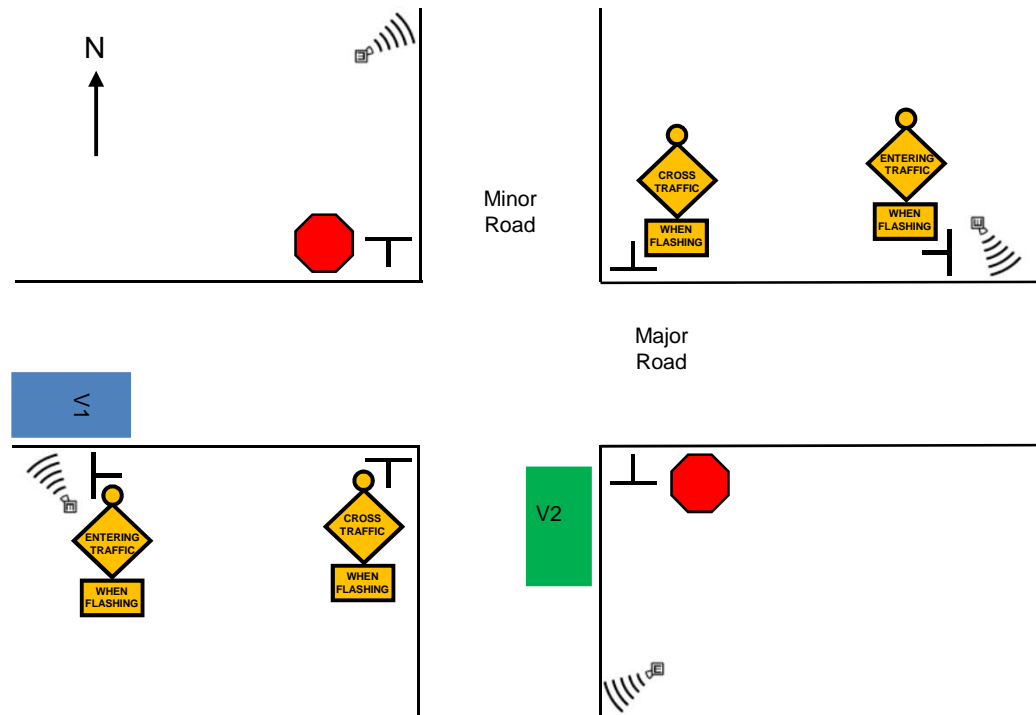
# Intersection Conflict Warning Systems

- *Crash Factors in Intersection-Related Crashes: An On-Scene Perspective* (NHTSA, 2010)
  - 96% of crashes attributed to drivers
    - 55.7% driver recognition errors
      - Inattention, internal and external distractions, inadequate surveillance, etc.
    - 29.2% driver decision errors
      - Too fast for conditions or aggressive driving, false assumption of other's actions, illegal maneuver, and misjudgment of gap or other's speed



# Intersection Conflict Warning Systems

**Intersection conflict warning systems (ICWS)** are used at stop-controlled intersections to provide drivers – on major or minor roads – with **dynamic warning** of other vehicles approaching the intersection



# Intersection Conflict Warning Systems

## Major Road Warning



# Intersection Conflict Warning Systems

## Minor Road Warning



# Intersection Conflict Warning Systems



# Intersection Conflict Warning Systems

**Major and major/minor  
road ICWS = 25-30%  
reduction (total crashes)\***

\* Evaluation of the Safety Effectiveness of “Vehicle Entering When Flashing” Signs and Actuated Flashers at 74 Stop-Controlled Intersections in North Carolina (2012)



# Design and Evaluation Guidance

Bring together organizations that have developed and deployed ICWS to **develop a consistent approach for accelerated, uniform deployment and further evaluation** of them, and to **recommend preliminary design and evaluation guidance** for MUTCD consideration.



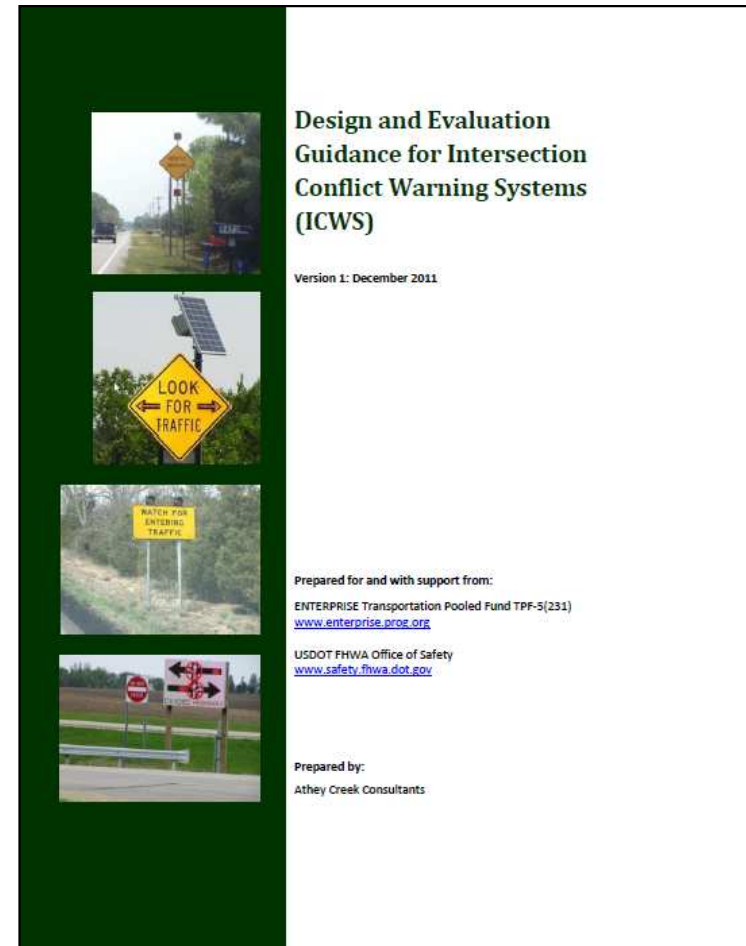
# Design and Evaluation Guidance

- Webinar (June 23, 2011)
  - **Shared knowledge** and educated each other on systems deployed
  - **Identified challenges** with future deployments
- Workshop #1 (July 28-29, 2011)
  - Discussed content of a preliminary **design guidance**
  - Discussed **roadmap** for reaching standardization
- Workshop #2 (September 15-16, 2011)
  - Reviewed preliminary **design guidance**
  - Developed **evaluation framework** that may be used in future deployments
  - Discussed **plans for future** deployment and coordination plans



# Design and Evaluation Guidance

- Design guidance
  - Four typical layouts based on warning direction and intersection configuration
  - Preliminary illustrations
  - Offer technical insight and recommended practice
  - Conditions, intended driver use, layout, options, notes and references



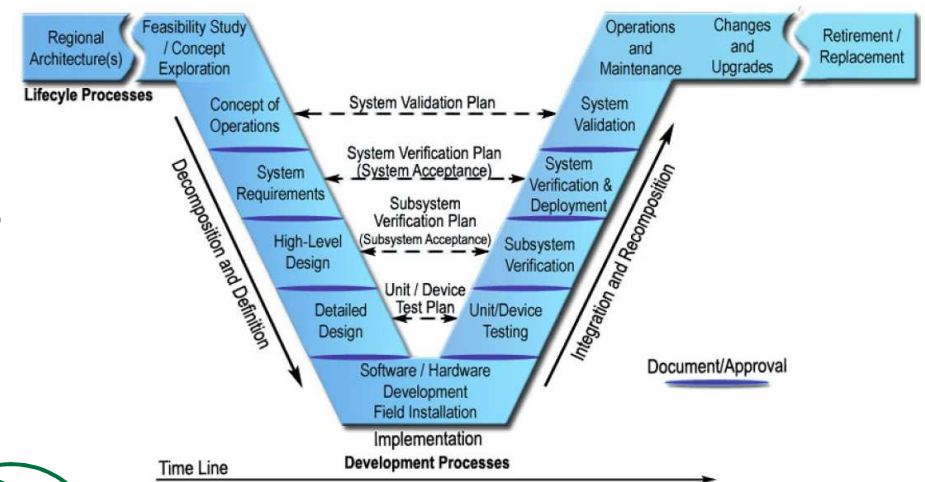
# Design and Evaluation Guidance

- Evaluation guidance
  - Not all systems have been formally evaluated
    - Acknowledged various evaluation approaches
  - Establish a common framework for evaluation
    - Individual and national
  - Based on ITS Evaluation Guidelines
    - Goal
    - Strategy
    - Hypotheses
    - Test plan parameters



# Systems Engineering

- Why develop a concept of operations or system requirements?
  - ICWS are intelligent transportation systems and FHWA requires systems engineering for ITS
  - Some agencies are unfamiliar with systems engineering
  - Time and budget aren't always available for adequate systems engineering



# Systems Engineering

Concept of operations and system requirements will **offer a starting point** for transportation agencies deploying ICWS



# Systems Engineering

- Concept of operations identifies stakeholders, needs, operational concept and system components
  - Traceability is emphasized throughout

Challenge	ID	Need
Continuous alerts can diminish the credibility and value of a dynamic warning for drivers.	5	<b>Drivers and transportation agencies</b> need alerts to be dynamic and not become nearly continuous so as to lose impact.

## 3.2 Operational Concept – Transportation Agency Perspective

**3.2.1** — Transportation agencies will not deploy ICWS where traffic volumes cause alerts to be displayed in a nearly continuous manner. **(5)**

System Component	Support Required
<b>Overall ICWS</b>	Determine where ICWS should be installed based on traffic volumes, speeds and intersection design characteristics for maximum safety effectiveness. <b>(3.2.1) (3.2.12) (3.2.14)</b>

# Systems Engineering

- System requirements define what ICWS must do and set the basis for system design, procurement, installation and operation
  - Traceable back to user needs

ID #	Needs	ID #	High Level Requirements	ID #	Detailed System Requirements
1	<b>Major road drivers</b> approaching an intersection equipped with ICWS <b>need an alert</b> to indicate when vehicles are approaching, at stop signs or at yield signs on the minor road.	1.1	ICWS <b>shall detect</b> all vehicles approaching and waiting at the stop or yield signs on the minor road.	1.1.1	ICWS <b>shall detect vehicles from both directions on the minor road</b> as they are a. approaching the intersection less than time $t$ , and b. as they are waiting at the stop sign or yield sign on the minor road.
<b>Considerations:</b> Yield sign location is included in this requirement to accommodate deployments on median-divided roadways.					

# Next Steps

- For ENTERPRISE work...
  - Finalize concept of operations by October 2012
  - Finalize system requirements by March 2013
  - Maintain coordination with key standards, industry and transportation organizations
  - Considering next steps with board in April 2013



# Next Steps

- Work beyond ENTERPRISE...
  - Traffic Control Devices TPF-5(065)
    - Human factors research on sign placement and legend
  - Evaluation of Low Cost Safety Improvements TPF-5(099)
    - Nationally oriented safety effectiveness evaluation
  - NCUTCD R/WSTC Task Force
    - Determine what may be needed for ICWS in MUTCD
  - AASHTO SCOTE
    - Resolution to SCOH
  - American Traffic Safety Services Administration
    - Collaboration with ENTERPRISE

# Next Steps

- More work beyond ENTERPRISE...
  - NCDOT safety effectiveness evaluation (2012)
    - Major and major/minor road ICWS = 25-30% reduction (total crashes)
    - May be even higher reduction for severe injury crashes
  - Iowa DOT deployments
    - Deployed fourth ICWS on 2/7
    - Fifth system installed late-summer 2013
  - MnDOT Rural ICWS project
    - Design-build deployment at 20-50 sites

# ENTER PRISE

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